

Spatial Orientation and Balance Control Changes Induced by Altered Gravito-inertial Force Vectors in Vestibular Deficient Patients

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## Spatial orientation and balance control changes induced by altered gravito-inertial force vectors in vestibular deficient patients

Eight chronic vestibular deficient (VD) patients (bilateral N = 4, unilateral N = 4, ages 18-67) were exposed to an interaural centripetal acceleration of 1 G (resultant 45° roll tilt of 1.4 G) on a 0.8 meter radius centrifuge for up to 90 minutes in the dark. The patients sat with head fixed upright, except every 4 of 10 minutes when instructed to point their nose and eyes towards a visual target (switched on every 3 to 5 seconds at random places within  $\pm 30$  deg) in the Earth horizontal plane. Eye movements, including directed saccades for subjective Earth- and head-referenced planes, were recorded before, during, and after centrifugation using electro-oculography. Postural sway was measured before and within ten minutes after centrifugation using a sway-referenced or earth-fixed support surface, and with or without a head movement sequence. The protocol was selected for each patient based on the most challenging condition in which the patient was able to maintain balance with eyes closed. Bilaterally VD patients showed no postural decrement after centrifugation, while unilateral VD patients had varying degrees of decrement, similar to normal subjects with no labyrinth deficiency. Unilateral VD patients were tested twice; they underwent centrifugation both with right ear out and left ear out on different days. In normal subjects, this orientation can be used to predict the post-centrifugation shift in the center of sway. No clear correlation between the direction of the shift in the post-centrifugation center of sway and the side of the lesion could be made in the four unilateral VD patients. However, in each patient their post-centrifugation center of sway shifted at right angles when comparing the left ear out and right ear out centrifuge GIF orientation. Bilateral VD patients had center of sway shifts as well, but no consistent directional trend. VD patients underestimated roll-tilt during centrifugation. These results support the hypothesis that otolith input, the orientation of the gravito-inertial vector and its magnitude are all used by the central nervous system for calibration of multiple orientation systems. (2167 characters)

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